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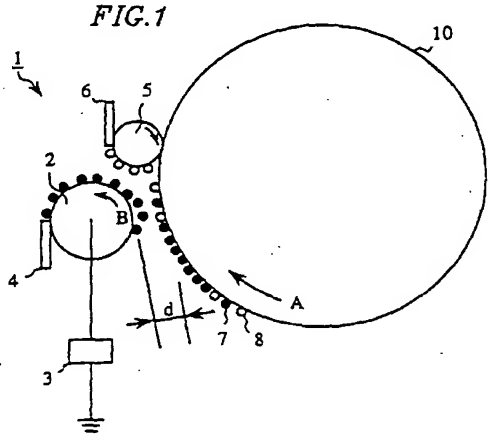
(54) Cleaning device for an image forming apparatus.

(57) A cleaning device is used in an image forming apparatus for removing residual substances on a surface of the image forming apparatus after an image forming operation including a process for developing an electro-static latent image formed by electrophotography on a surface of an image data forming body of the image forming apparatus and a process for transferring the developed image onto a recording medium. The cleaning device includes a first cleaning device (2) for removing residual toner (7) from the surface of the image data forming body (10); and a second cleaning means (5) for removing an adhering substance (8) different from the toner from the surface of the image data forming body. The second cleaning device (5) is located downstream with respect to the first cleaning device (2) in a direction (A) in which the image forming operation proceeds.

FIG.1



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BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to a cleaning device for removing residual substances remaining on a surface of an image data forming body after a series of image forming processes is completed in an image forming apparatus using electrophotography such as a copier, a laser printer, or a facsimile apparatus.

2. Description of the Related Art:

With reference to Figure **12**, a general image forming apparatus using electrophotography will be described. A general image forming apparatus includes a photoconductive body **90** on which image data is to be formed. The image forming apparatus further includes a main charger **91**, a developing device **93**, a transfer charger **94**, and a charge removing lamp **95** which are located opposed to the photoconductive body **90**. When a photoconductive body **90** rotates in the direction of arrow **A**, a surface of the photoconductive body **90** is supplied with a uniform charge by corona discharge which is performed by the main charger **91**. When the surface is exposed to light by an exposing device **92**, an electrostatic latent image is formed on the surface. The electrostatic latent image is developed into a toner image by toner **81** which is supplied from the developing device **93**. A recording medium such as a paper sheet **97** is transported between the photoconductive body **90** and the transfer charger **94**, and the toner image on the surface of the photoconductive body **90** is transferred onto the paper sheet **97** by corona discharge which is performed by the transfer charger **94**. The image formed on the paper sheet **97** is fixed by heat and pressure supplied by a fixing device (not shown).

In the transference of the above-described image forming operation, the toner image on the surface of the photoconductive body **90** is not entirely transferred onto the paper sheet **97**. Accordingly, after the transference, the toner used for the formation of the toner image partially remains as residual toner **82**. Further, substances generated by the corona discharge, paper powders included in the paper sheet **97**, and talc adhere to the surface of the photoconductive body **90**. Such substances are represented by an adhering substance **83** in Figure **12**. The residual toner **82** and the adhering substance **83** have unfavorable influence on the following image formation and thus lower image quality. In order to avoid such a problem, a cleaning device such as a cleaning blade **96** is provided between the transfer charger **94** and the charge removing lamp **95**. A tip of the cleaning blade **96** contacts the surface of the photoconductive body **90** and thus scrapes off the residual toner **82** and the adhering substance **83** from the surface. Another known cleaning device includes a fur brush or a cleaning roller, which are put into contact with the surface of the photoconductive body **90** to remove the residual toner **82** and the adhering substance **83**.

Japanese Patent Publication Nos. 5-17552 and 5-23436 each disclose provision of an air absorbing opening or an air blowing opening in the vicinity of the surface of the photoconductive body, through which the residual substances are absorbed or blown off without physical contact. Japanese Laid-Open Patent Publication No. 62-67577 discloses provision of a metal roller having a rotation axis parallel to the photoconductive body. The metal roller is supported with a gap from the surface of the photoconductive body and is supplied with a bias voltage obtained by superimposing a DC bias voltage and an AC bias voltage, thus to absorb the toner to the surface of the metal roller.

In a device including a member such as a cleaning blade which removes the residual substances by contacting the surface of the photoconductive body, an area of the surface to be contacted with such a member needs to have a sufficient hardness. Further, since such a member needs to contact the area at a relatively large load, it is possible that a coat of toner or talc is formed on the surface or that the surface is damaged by paper powders formed of rugged grains. For these reasons, the image quality is lowered, and the life of the photoconductive body is shortened.

By the above-mentioned system of absorbing air from the surface of the photoconductive body, the image forming apparatus needs to be provided with a relatively large absorption apparatus. After a continuous use over a long period of time, residual substances are clogged in the air absorbing opening, thereby lowering the absorbing capability. Further, maintenance including replacement of filters for separating the toner from the absorbed air is required. By the above-mentioned system of blowing air to the photoconductive body, the image forming apparatus needs to be provided with an air supply apparatus, and thus the size thereof is inevitably enlarged. A blade which comes in contact with the surface of the photoconductive body is provided in order to introduce the air to the surface of the photoconductive body efficiently. Such a blade causes formation of a coat of toner or talc or damage of the surface by paper powders. Further, maintenance including replacement of filters for separating the toner from the exhausted air is required.

In the above-mentioned system of causing the residual toner to adhere to the metal roller which is supplied with a bias voltage, non-magnetic substances such as paper, powders or talc cannot be removed.

SUMMARY OF THE INVENTION

A cleaning device which is used in an image form-

ing apparatus for removing residual substances on a surface of the image forming apparatus after an image forming operation including a process for developing an electrostatic latent image formed by electrophotography on a surface of an image data forming body of the image forming apparatus and a process for transferring the developed image onto a recording medium includes a first cleaning device for removing residual toner from the surface of the image data forming body; and a second cleaning device for removing an adhering substance different from the toner from the surface of the image data forming body. The second cleaning device is located downstream with respect to the first cleaning means in a direction in which the image forming operation proceeds.

In one embodiment of the invention, the first cleaning device includes a first recovering member located opposed to the surface of the image data forming body with a gap from the image data forming body and a power supply device for applying a bias voltage to the first recovering member, and the second cleaning device includes a second recovering member having a sufficient flexibility to slide on the surface of the image data forming body in pressure contact with the surface of the image data forming body.

According to the present invention, residual toner and the other residual substances adhering to the surface of the photoconductive body are removed separately by the first cleaning device and the second cleaning device. Due to such an operation, the first cleaning device and the second cleaning device may be formed of a material which has suitable properties for the toner or the other substance to be removed and performs the removal with certainty without damaging the surface of the image data forming body or causing formation of a coat of the toner or the other residual substances.

Further according to the present invention, a bias voltage between the first recovering member and the image data forming body is applied from the power supply device to the first recovering member which is located opposed to the surface of the image data forming body with a gap therefrom. Thus, the residual toner on the surface of the image data forming body is attracted from the surface of the image data forming body to the first recovering member. The second recovering member is located downstream with respect to the first recovering member in a direction in which the image forming operation proceeds. The second recovering member flexibly slides on the surface of the image data forming body in a pressure contact state. The adhering substances different from the toner are removed from the image data forming body by the second recovering member. In this manner, the toner and the other substances which remain on the surface of the image data forming body after a series of image forming process s is completed can be removed separately by the first and second recovering members. Due to such separat recov ry, the toner can be reus d. Moreover, since it is n t n cessary to remove the toner or other adhering substances by a member contacting the surface of the image data forming body, the pressure of contact of the second recovering member to the image forming device can be sufficiently low. Accordingly, formation of a coat by talc and damaging of the surface by paper powders can be avoided.

Thus, the invention described herein makes possible the advantage of providing a cleaning device used for an image forming apparatus, for removing residual substances on a surface of a photoconductive body in accordance with the type of the substances without damaging the surface or causing a coat of toner or talc to be formed on the surface, thus to extend the life of the photoconductive body and raise the speed of the image forming operation.

This and other advantages of the present invention will become apparent to those skilled in the art upon reading and understanding the following detailed description with reference to the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of a cleaning device used in an image forming apparatus in a first example according to the present invention.

Figure 2 is a schematic view of a cleaning device used in an image forming apparatus in a second example according to the present invention.

Figure 3 is a graph illustrating the cleaning efficiency by a function of the volume resistivity of a roller supplied with a bias voltage in the cleaning device in the second example.

Figure 4 is a graph illustrating the cleaning efficiency by a function of the ratio of the circumferential speed of another roller with respect to the circumferential speed of a photoconductive drum in the second example.

Figure 5 is a graph illustrating the cleaning efficiency by a function of the ratio of the circumferential speed of the roller supplied with a bias voltage with respect to the circumferential speed of the photoconductive drum in the second example.

Figure 6 is a schematic view of a cleaning device used in an image forming apparatus in a third example according to the present invention.

Figure 7 is a schematic view of a cleaning device used in an image forming apparatus in a modification of the third example according to the present invention.

Figure 8 is a graph illustrating the cleaning efficiency by a function of the frequency of the bias voltag applied t a roller in the third xampl .

Figure 9 is a graph illustrating the cleaning fficiency by a function of the peak-to-p ak voltage.

Figure **10** is a schematic view of a cleaning device used in an image forming apparatus in a fourth example according to the present invention.

Figure **11** is a schematic view of a cleaning device used in an image forming apparatus in a fifth example according to the present invention.

Figure **12** is a schematic view of a part of an image forming apparatus including a conventional cleaning device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, the present invention will be described by way of illustrative examples with reference to the accompanying drawings.

Example 1

A cleaning device for an image forming apparatus in a first example according to the present invention will be described with reference to Figure **1**. Figure **1** schematically shows a structure for a cleaning device **1** in the first example.

The image forming apparatus including the cleaning device **1** also includes a photoconductive drum **10** as a photoconductive member on which image data is formed. The photoconductive drum **10** having a cylindrical shape with an outer diameter of 80 mm and a length of 310 mm includes a drum base formed of aluminum and an organic photoconductive layer (hereinafter, referred to as an "OPC layer") formed on an outer circumferential surface thereof. The photoconductive drum **10** rotates in the direction of arrow **A** at a circumferential speed of 175 mm/sec. The photoconductive member may include a sheet base instead of a drum base, and the drum base or the sheet base may be formed of other materials instead of aluminum.

A surface of the photoconductive drum **10** is charged by a main charger (not shown) to have an opposite polarity to the polarity of toner. An electrostatic latent image is formed on the surface of the photoconductive drum **10** by exposure performed in accordance with image data. Toner is supplied to the surface of the photoconductive drum **10** by a developing device (not shown), thereby developing the electrostatic latent image into a toner image. Then, the toner image is transferred on a paper sheet by a transfer device (not shown). After the transference is completed, residual toner **7** and the other substances (illustrated as an adhering substance **8** in Figure **1**) adhere to the surface of the photoconductive drum **10**. The main charger and the transfer device may be of any known type.

The cleaning device **1** includes a roller **2** as a first recovering member, a power supply circuit **3** as power supply means for providing a bias voltage to the roller **2**, and a blade **4** for scratching off the residual toner **7** covered from a surface of the roller **2**. The roller **2** is supported opposed to the photoconductive drum **10** with a small gap **d** from the surface of the photoconductive drum **10**. A rotation axis of the roller **2** is parallel to a rotation axis of the photoconductive drum **10**, and the roller **2** is rotatable in the direction of arrow **B**.

The roller **2** has a shape of a hollow or solid cylinder, and is formed of a non-insulative material containing (1) a conductive metal material such as aluminum, copper, iron and an alloy thereof or (2) a conductive or a semi-conductive organic polymer material such as rubber or plastics including a conductive material such as carbon. The roller **2** may have a multiplelayer structure covered with a conductive or a semi-conductive organic polymer material including a conductive material such as carbon.

The non-insulative metal material has a satisfactory strength, a satisfactory resistance against wearing, and the like. A desirable bias voltage can be applied to the roller **2** formed of such a material. The conductive or semi-conductive organic polymer material containing a conductive material such as carbon may be a plastic material such as FRP which contains a conductive fiber such as carbon fiber diffused in engineering plastics, conductive engineering plastics or rubber, conductive ceramics, or a functionally gradient material.

In the first example, the roller **2** is a hollow aluminum cylindrical roller having a diameter of 20 mm and a length of 310 mm. The surface of the roller **2** is smooth. The roller **2** is located opposed to the photoconductive drum **10** with a gap **d** of 200 μm from the surface of the photoconductive drum **10**. The gap **d** may be desirably set in accordance with mechanical or electrical restrictions.

The roller **2** is supplied with, for example, a DC bias voltage by the power supply circuit **3**. By application of the DC bias voltage to the roller **2**, particles of the residual toner **7** which are residual on the surface of the photoconductive drum **10** are attracted to the surface of the roller **2**. By contact of the blade **4** with the surface of the roller **2**, the particles of the residual toner **7** adhering to the surface of the roller **2** are scratched off and then are recovered to a recovering bottle (not shown).

The cleaning device **1** further includes a roller **5** as a second recovering member and a blade **6** for scratching off the adhering substance **8** from the surface of the roller **5**. The roller **5** has a shape of a hollow or solid cylinder, and is formed of an insulative elastic material containing an organic polymer material such as solid rubber or porous foamed rubber. The roller **5** may be a brush-like roller formed of an organic polymer material such as an insulative fiber material. The roller **5** is rotatable in the same direction as the photoconductive drum **10**.

The insulative plastic material may be an organic polymer material such as urethane which is sufficiently easy to mold and to produce, solid rubber formed of silicon or the like, or porous foamed rubber.

In the first example, the roller **5** is a solid insulative and elastic cylindrical roller which is formed of independent foamed urethane and has a diameter of 20 mm, a length of 310 mm, and a hardness of 50°. The roller **5** is located in contact with the photoconductive drum **10** with a pressure of 200 gf/cm. The pressure of contact can be desirably set based on the material and the smoothness of the surface of the photoconductive drum **10** and the speed of the image forming operation.

The roller **5** having the above-described structure and properties flexibly slides on the surface of the photoconductive drum **10** in pressure contact with the surface. Thus, mainly the adhering substance **8** is recovered from the surface of the photoconductive drum **10** to the surface of the roller **5** by a mechanical shearing force generated by such relative movement of the photoconductive drum **10** and the roller **5**. The adhering substance **8** is then scratched off from the surface of the roller **5** by the blade **6** through contact of the blade **6** with the surface of the roller **5** and then is recovered into a recovering bottle (not shown).

Example 2

With reference to Figure **2**, a cleaning device of an image forming apparatus in a second example according to the present invention will be described. Figure **2** is a schematic view of a cleaning device **20** in the second example. In the second example, the roller **2**, the power supply circuit **3**, the blade **4**, the roller **5**, the blade **6**, and the photoconductive drum **10** are the same as those in the first example, and thus detailed description thereof will be omitted.

The roller **5** is supplied with a DC bias voltage by a power supply device **11**. The DC bias voltage has an opposite polarity to the polarity of the adhering substance **8**. The roller **5** slides on the surface of the photoconductive drum **10** in pressure contact therewith flexibly. The adhering substance **8** is recovered from the surface of the photoconductive drum **10** to the surface of the roller **5** by an electrostatic force generated by the application of the DC bias voltage as well as a mechanical shearing force.

Figure **3** is a graph illustrating the cleaning efficiency by a function of the volume resistivity of the roller **5** in the cleaning device **1**. As is described above, the roller **5** is a solid cylindrical roller formed of a non-insulative elastic material. For example, the roller **5** is formed of an organic polymer material such as a semi-conductive solid rubber or a porous foamed rubber containing a conductive material such as carbon. As is illustrated in Figure **3**, when the volume resistivity of the roller **5** is less than $1 \times 10^7\ \Omega\cdot cm$, a coat of the adhering substance **8** is formed on the surface of the photoconductive drum **10** by an excessive current flowing through the roller **5**. When the volume resistivity of the roller **5** is more than $1 \times 10^9\ \Omega\cdot cm$, the volume resistivity is non-uniform in different parts of the surface of the same roller **5**, thereby reducing the cleaning efficiency. Accordingly, the volume resistivity of the roller **5** is preferably between $1 \times 10^7\ \Omega\cdot cm$ and $1 \times 10^9\ \Omega\cdot cm$ to obtain satisfactory cleaning performance.

Figure **4** is a graph illustrating the cleaning efficiency by a function of the ratio of the circumferential speed of the roller **2** with respect to the circumferential speed of the photoconductive drum **10** in the second example. As is appreciated from Figure **4**, by rotating the roller **2** and the photoconductive drum **10** in opposite directions from each other while the above-mentioned ratio is between 50% and 500%, the residual toner **7** which has been recovered to the roller **2** is not scattered. The above-mentioned ratio is preferably between 100% and 300% in order to separate the residual toner **7** from the surface of the photoconductive drum **10** more easily. In this manner, more satisfactory cleaning performance can be achieved.

Figure **5** is a graph illustrating the cleaning efficiency by a function of the ratio of the circumferential speed of the roller **5** with respect to the circumferential speed of the photoconductive drum **10**. As is appreciated from Figure **5**, by rotating the roller **5** and the photoconductive drum **10** in the same direction while the above-mentioned ratio is between 50 and 500%, the adhering substance **8** can be recovered satisfactorily. Especially when the above-mentioned ratio is 100% or more, the cleaning efficiency rises sharply. When the above-mentioned ratio exceeds 200%, the mechanical shearing force between the roller **5** and the surface of the photoconductive drum **10** is excessively large, causing fluctuation in the rotation load between the roller **5** and the photoconductive drum **10** and other inconveniences. Accordingly, the above-mentioned ratio is preferably between 100% and 200%.

Example 3

With reference to Figure **6**, a cleaning device in a third example according to the present invention will be described. Figure **6** shows a schematic structure for a cleaning device **30** in the third example.

As is illustrated in Figure **6**, the cleaning device **30** includes a DC power supply circuit **13** and an AC power supply circuit **14** instead of the power supply circuit **3** shown in Figures **1** and **2**. The other elements of the cleaning device **30** are the same as those in the previous examples, and detailed description thereof will be omitted.

By the above-described structure, the roller **2** as a first covering member for covering the residual

toner **7** from the surface of the photoconductive drum **10** is supplied with a DC bias voltage from the DC power supply circuit **13** and also with an AC bias voltage from the AC power supply circuit **14**.

The levels of the bias voltages supplied by the DC power supply circuit **13** and the AC power supply circuit **14** are determined in accordance with various conditions such as the size of the gap **d**. For example, when the gap **d** is 200 μm, the absolute value of the amplitude of only the DC bias voltage in one of the two polarities is larger than the absolute value of the potential at which the photoconductive drum **10** is charged, but is 2.7 kV or less. Further, in order to allow the residual toner **7** to vibrate easily electrostatically, the frequency of the AC bias voltage is set to 3 kHz, and a peak-to-peak voltage of 2 kVp-p is applied. At this point, a DC bias voltage of -200 V is applied.

The AC bias voltage is applied to allow the residual toner **7** to vibrate electrostatically and may have a square waveform, a rectangular waveform, a triangular waveform, a waveform obtained by differentiating the rectangular waveform, or a waveform obtained by integrating rectangular waveforms. The AC bias voltage may have any other waveform which vibrates to both of the polarities with respect to the level of the DC bias voltage.

By applying a DC bias voltage and an AC bias voltage to the roller **2**, an electrostatic vibrating force acts on the residual toner **7** on the surface of the photoconductive drum **10** by the AC bias voltage. In detail, the particles of the residual toner **7** adhere to the surface of the photoconductive drum **10** in multiple layers. By the vibrating force supplied by the AC bias voltage, the particles of the residual toner **7** jump reciprocally one after another starting from the particles in the outermost layer. The particles hit one another appropriately in repetition, and thus go into the state of floating in the gap **d** between the surface of the photoconductive drum **10** and the surface of the roller **2**. In this manner, the adhesion of the residual toner **7** to the surface of the photoconductive drum **10** is alleviated by the AC bias voltage, and the residual toner **7** is attracted to the surface of the roller **2** more easily by the DC bias voltage.

In the case that the cleaning device is provided with the power supply device **11** as is shown in Figure **7**, the same effects are obtained.

Figure **8** is a graph illustrating the cleaning efficiency by a function of the frequency of the bias voltage applied to the roller **2** in the cleaning device **30**. Figure **9** is a graph illustrating the cleaning efficiency by a function of the peak-to-peak voltage applied to the roller **2**. As is appreciated from Figures **8** and **9**, in the case when a voltage obtained by superimposing a DC bias voltage and an AC bias voltage is applied to the roller **2** while the charge-to-mass ratio of the residual toner **7** is 13 μC/g, the AC bias voltage preferably has a frequency of 500 Hz to 6 kHz and a peak-to-peak voltage of 500 Vp-p to 5 kVp-p. More preferably, such an AC bias voltage has a frequency of 1.5 to 6 kHz and a peak-to-peak voltage of 1 to 4 kVp-p. By such voltage application, the powders of the residual toner **7** are put into the floating state at a higher efficiency, and thus the residual toner **7** is more easily separated from the surface of the photoconductive drum **10**. As a result, the cleaning efficiency is significantly improved. It is considered that the residual toner **7** goes into the floating state more easily by the above-described voltage application because the threshold voltage and the resonance frequency for causing the residual toner **7** to float and other factors are stabilized.

The cleaning efficiency indicated in Figures **3**, **4**, **5**, **8**, and **9** were obtained from the optical density of the toner adhering to the photoconductive drum **10** before and after the cleaning. In detail, the measurement of the optical density was performed as follows in accordance with JIS K7611 "Method for Measuring Photographic Characteristics of General Photographic Paper". The toner adhering on the photoconductive drum **10** was peeled off by a tape, and the density of the toner adhering to the tape was optically measured by a reflection densitometer. Such measurement was performed before and after the cleaning, and the cleaning efficiency was obtained from equation:

$$CR = (1 - R) \times 100$$

where CR indicates the cleaning efficiency and R indicates the ratio of the densities obtained before and after the cleaning.

Example 4

Figure **10** schematically illustrates a structure for a cleaning device **40** used in an image forming apparatus in a fourth example according to the present invention.

As is illustrated in Figure **10**, the cleaning device **40** includes a corona discharger **19** and a charge removing lamp **20** upstream with respect to the roller **2** acting as a first recovering member in a direction in which the image forming operation proceeds. The corona discharger **19** may be of a corotron type or a scorotron type. By the corona discharger **19** and the charge removing lamp **20**, the residual charge on the surface of the photoconductive drum **10** is removed. Accordingly, the adhesion of the residual toner **7** to the surface of the photoconductive drum **10** is weakened. Thus, the toner recovering capability of the roller **2** is improved, resulting in an improved cleaning efficiency.

Example 5

Figure **11** schematically illustrates a structure for a cleaning device **50** used in an image forming apparatus in a fifth example according to the present in-

vention.

As is illustrated in Figur 11, th cleaning d vice 50 includes a transporting screw 22 extending b - tween the roller 2 acting as a first recovering member and a developing device 21 of the image forming apparatus. By such a structure, the residual toner 7 recovered from the surface of the photoconductive drum 10 to the roller 2 is scratched off from the surface of the roller 2 by the blade 4 and then is transported to a developing tank of the developing device 21 by the transporting screw 22. In this manner, the toner can be reused efficiently.

According to the present invention, residual toner and the other substances remaining on a surface of a photoconductive drum can be recovered separately by two different rollers. By such an operation, satisfactory cleaning can be performed over a long period of time without damaging the photoconductive drum. As a result, the life of the photoconductive drum is extended and also the speed of the image forming operation is raised.

Further according to the present invention, one of the rollers is supplied with a bias voltage between the roller and the image data forming body and slides flexibly on the surface of the photoconductive drum in a pressure contact state. The residual toner on the surface of the photoconductive drum can be recovered with certainty by an electrostatic force of such a roller, and the other substances such as paper powders and talc adhering to the surface of the photoconductive drum can also be recovered reliably by a mechanical shearing force generated by the relative movement of the roller and the photoconductive drum in a pressure contact state.

Various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be broadly construed.

Claims

1. A cleaning device used in an image forming apparatus for removing residual substances on a surface of the image forming apparatus after an image forming operation including a process for developing an electrostatic latent image formed by electrophotography on a surface of an image data forming body of the image forming apparatus and a process for transferring the developed image onto a recording medium, the cleaning device comprising:

   first cleaning means for removing residual toner from the surface of the image data forming body; and

   second cleaning m ans for removing an adhering substance different from the toner from the surface of th image data forming body, the second cleaning means being located downstream with respect to the first cleaning means in a direction in which the image forming operation proceeds.

2. A cleaning device according to claim 1, wherein:

   the first cleaning means includes a first recovering member located opposed to the surface of the image data forming body with a gap from the image data forming body and power supply means for applying a bias voltage to the first recovering member, and

   the second cleaning means includes a second recovering member having a sufficient flexibility to slide on the surface of the image data forming body in pressure contact with the surface of the image data forming body.

3. A cleaning device according to claim 2, wherein the second cleaning means includes a further power supply means for applying a bias voltage to the second recovering member.

4. A cleaning device according to claim 2, wherein the power supply means of the first cleaning means is a DC power supply circuit.

5. A cleaning device according to claim 2, wherein the power supply means of the first cleaning means includes a DC voltage supply circuit and an AC voltage supply circuit.

6. A cleaning device according to claim 5, wherein the AC voltage supply circuit supplies an AC voltage having a waveform which vibrates to both of the polarities with respect to the level of a DC voltage supplied by the DC voltage supply circuit.

7. A cleaning device according to claim 3, wherein the further power supply means of the second cleaning means is a DC power supply circuit.

FIG.1

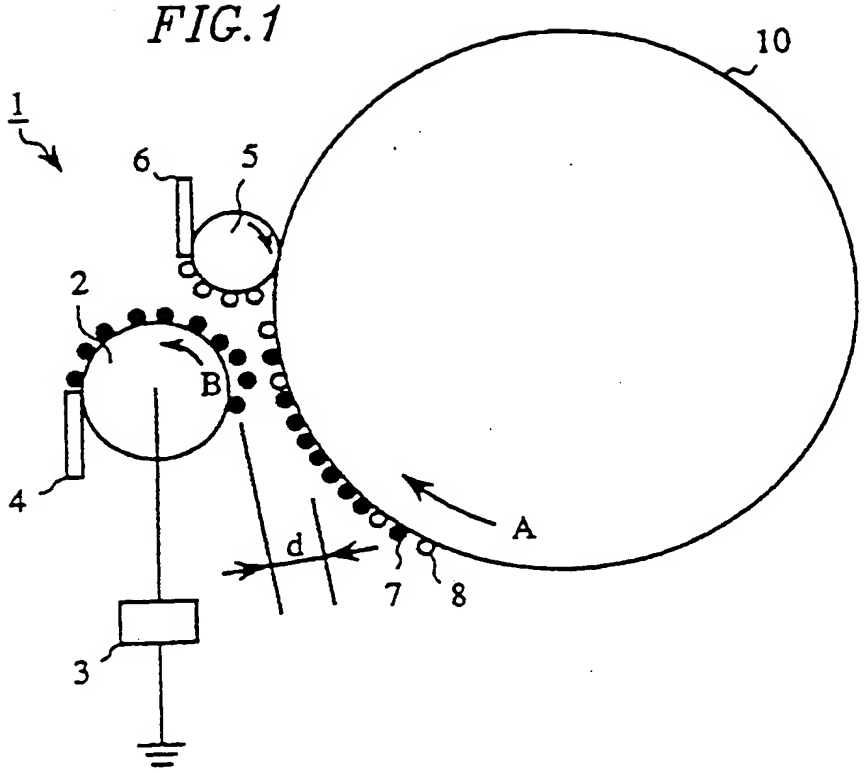


FIG. 2

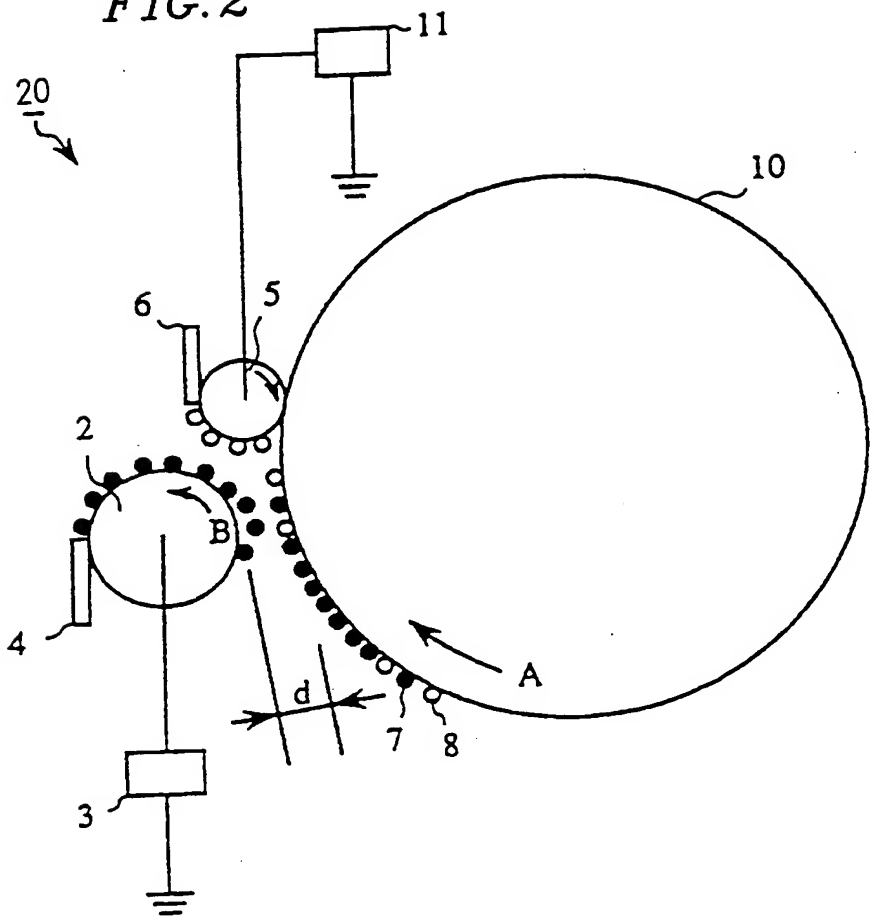


FIG. 3

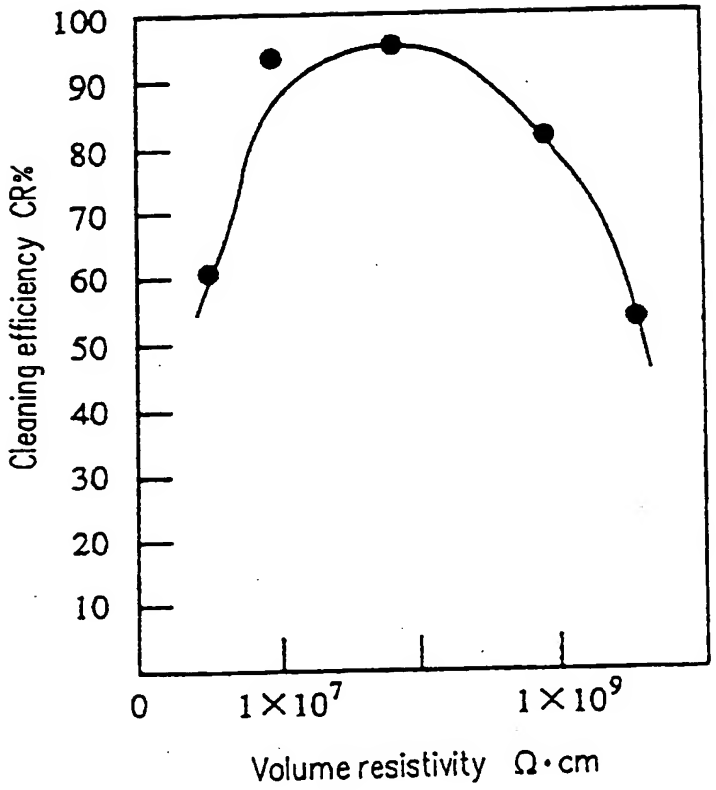

100
90
80
70
60
50
40
30
20
10
Cleaning efficiency CR%
0
1×10^7
1×10^9
Volume resistivity Ω·cm

FIG. 4

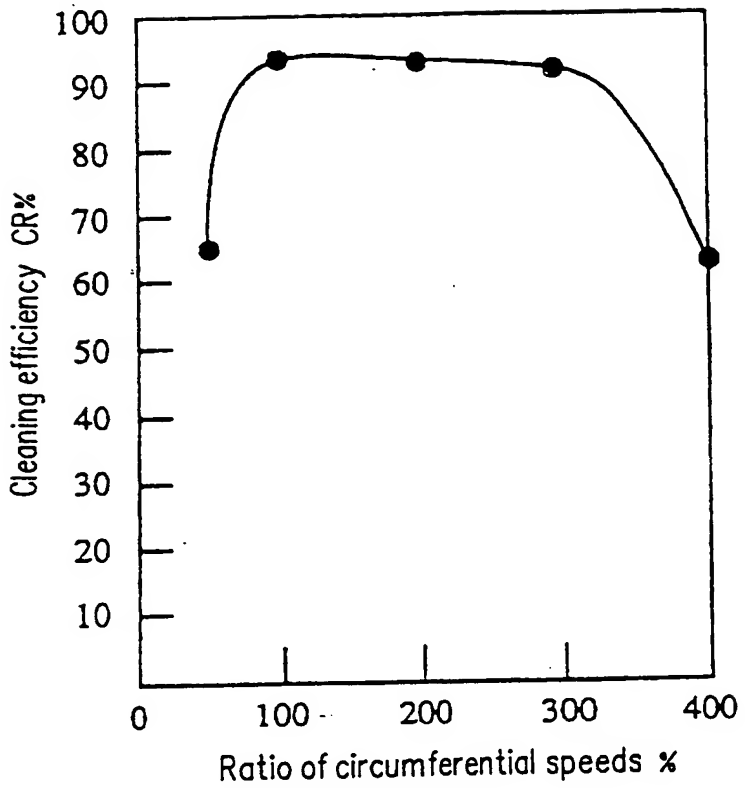

100
90
80
70
60
50
40
30
20
10
Cleaning efficiency CR%
0
100
200
300
400
Ratio of circumferential speeds %

FIG. 5

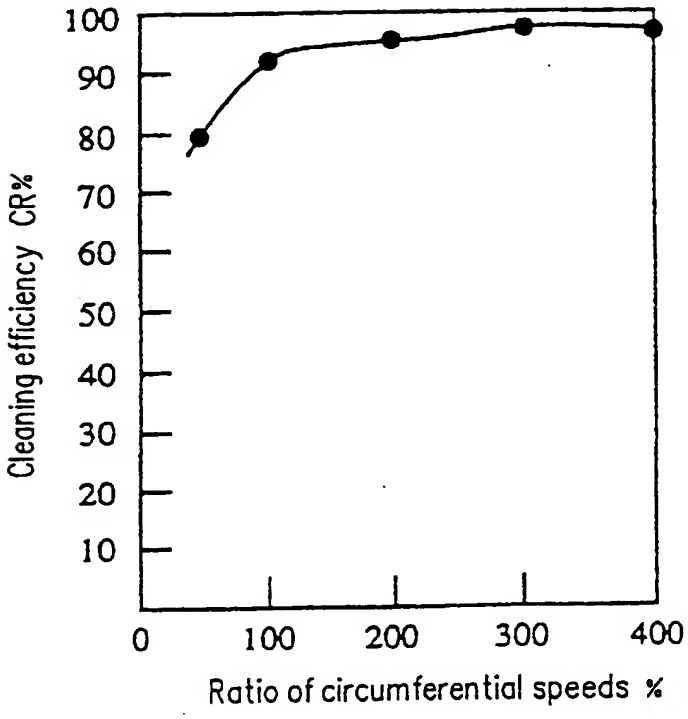

100
90
80
70
60
50
40
30
20
10
Cleaning efficiency CR%
0
100
200
300
400
Ratio of circumferential speeds %

FIG. 6

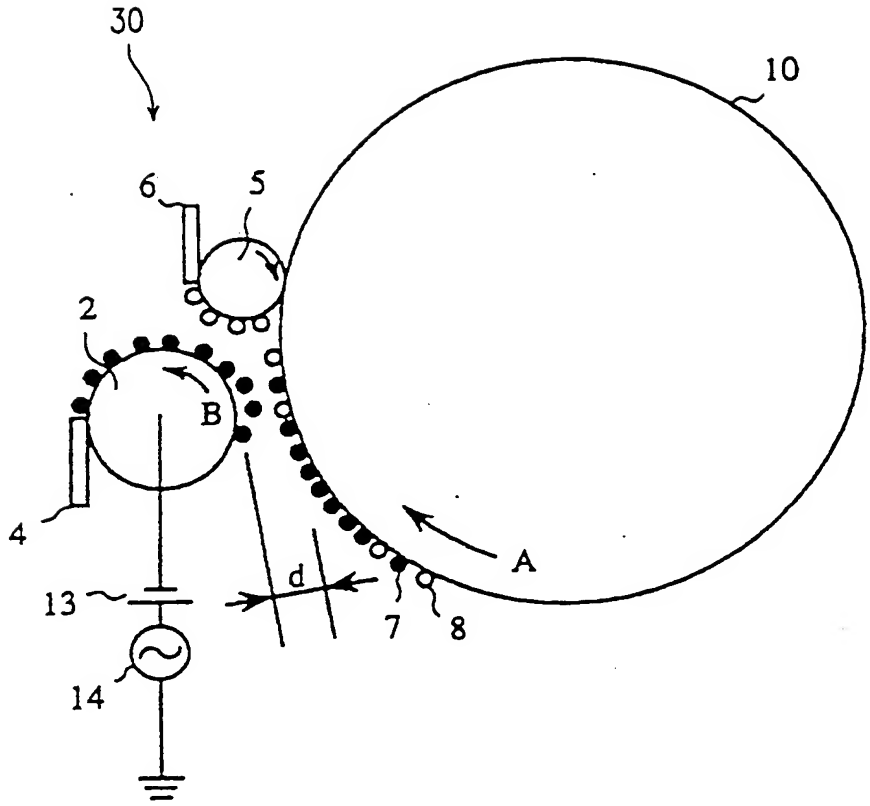


FIG. 7

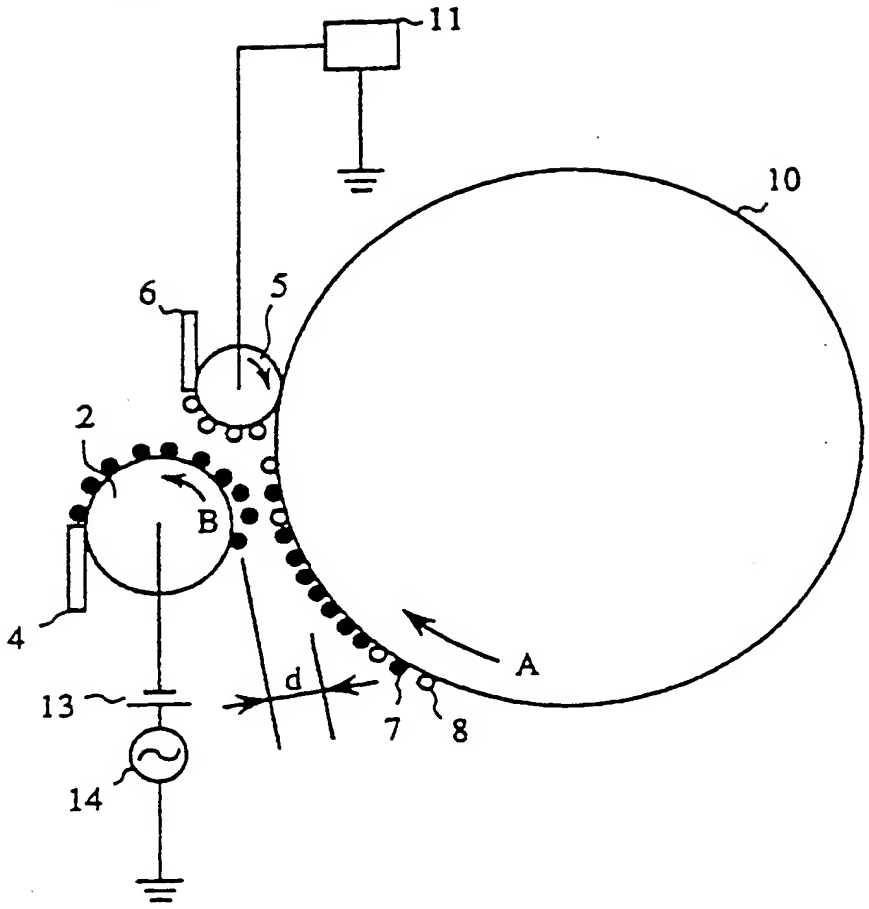


FIG. 8

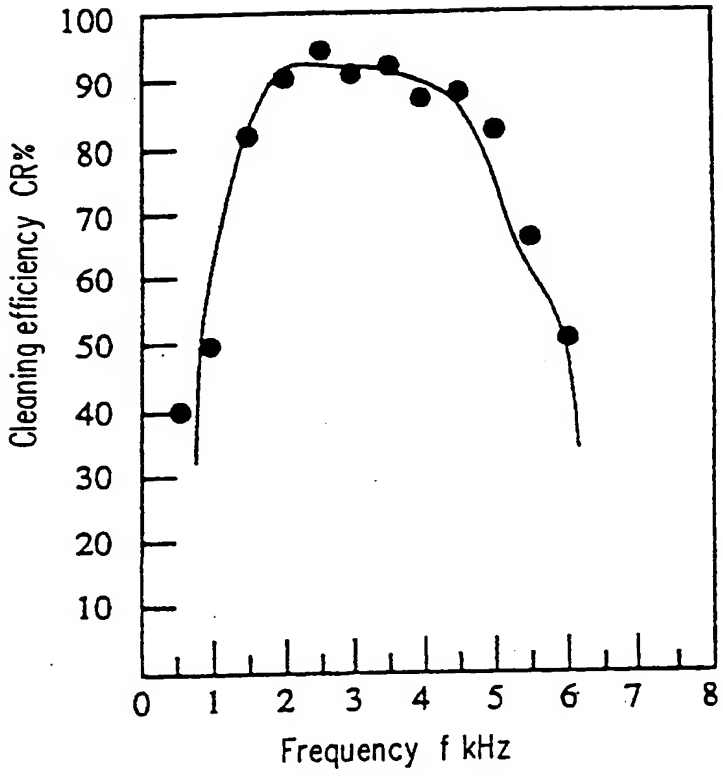

100
90
80
70
60
50
40
30
20
10
Cleaning efficiency CR%
0
1
2
3
4
5
6
7
8
Frequency f kHz

FIG. 9

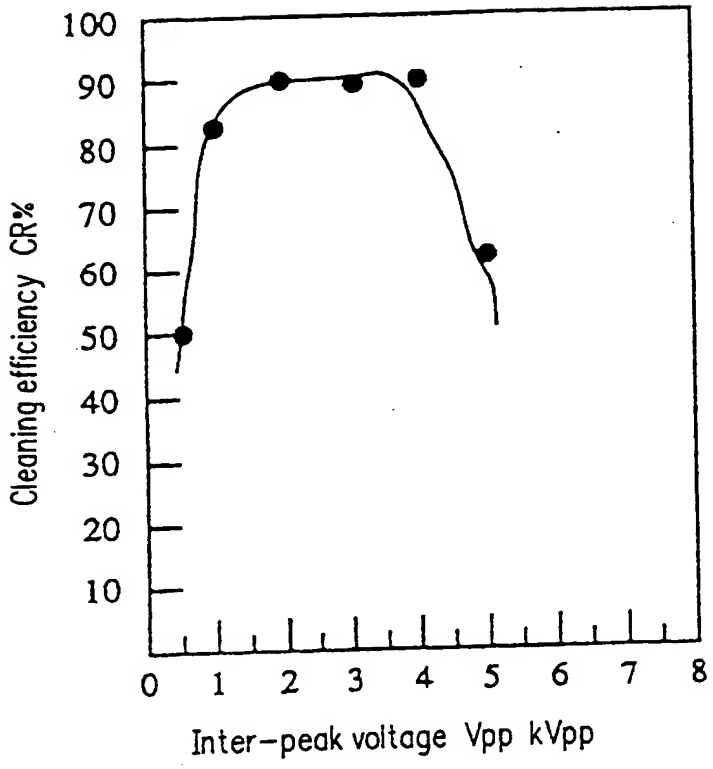
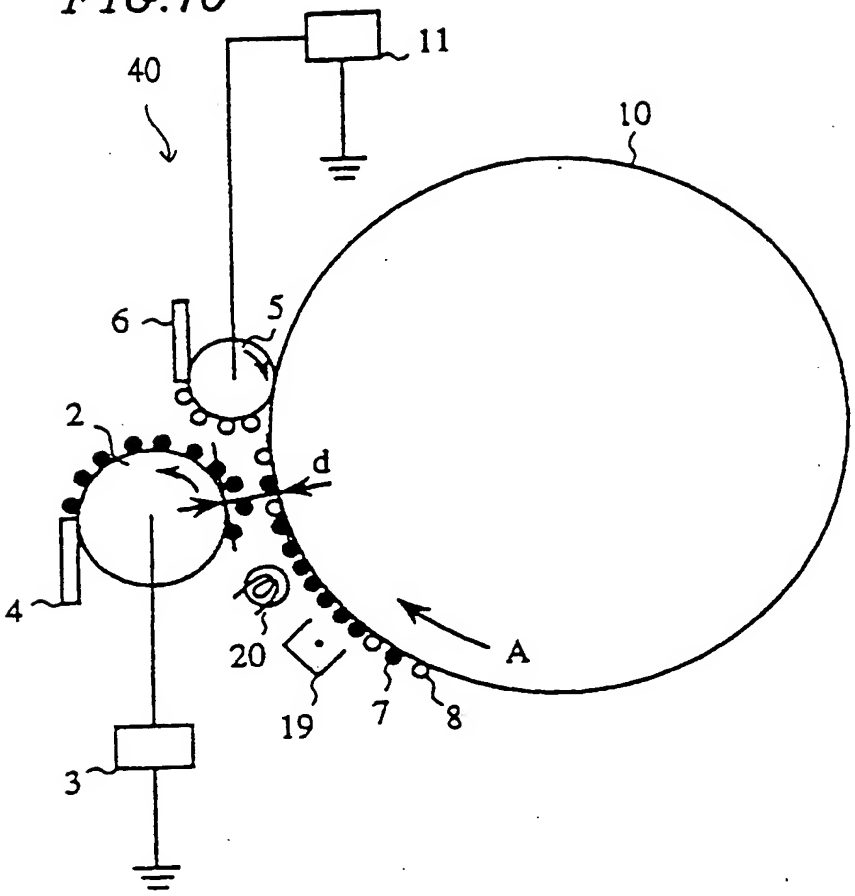

100
90
80
70
60
50
40
30
20
10
Cleaning efficiency CR%
0
1
2
3
4
5
6
7
8
Inter-peak voltage Vpp kVpp

FIG.10



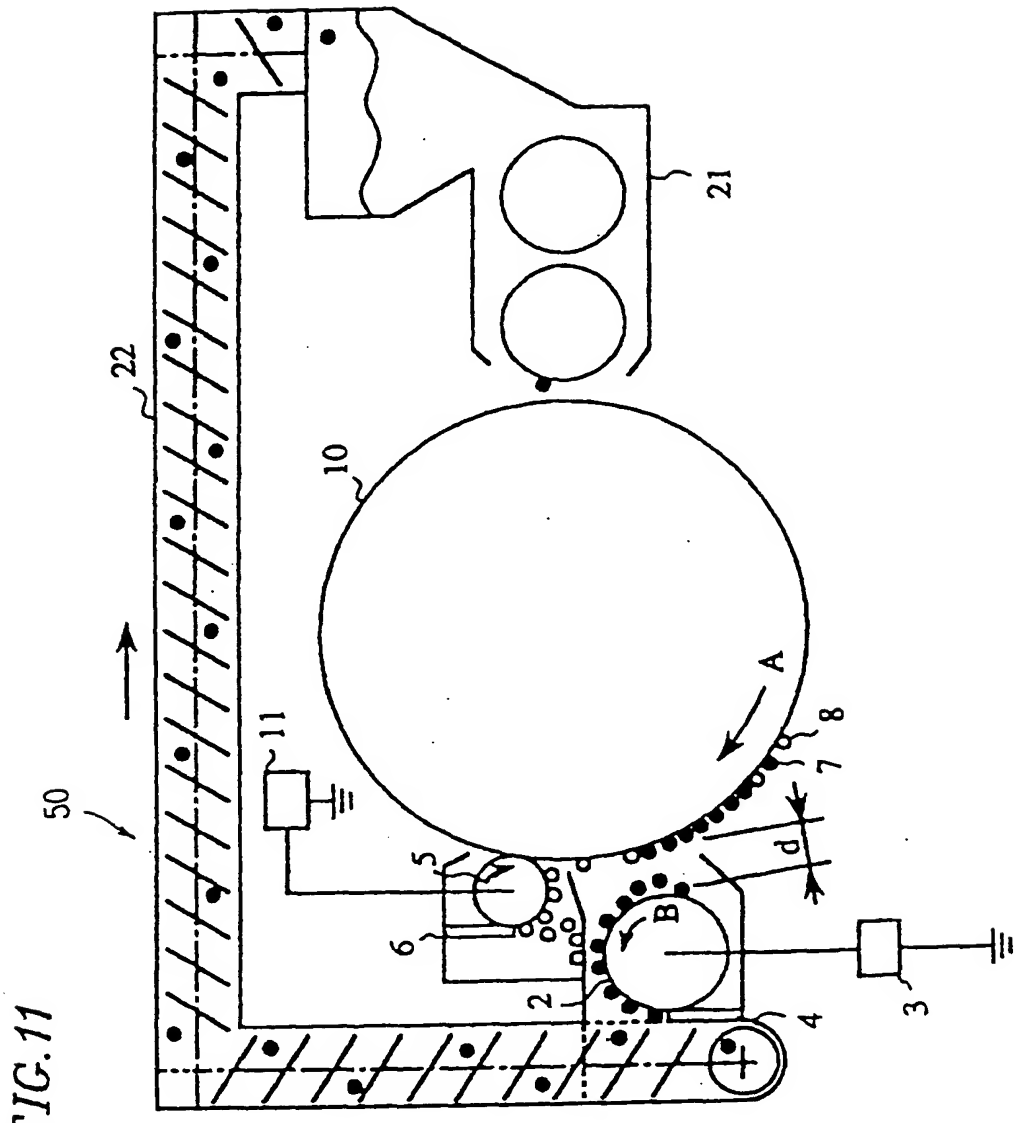
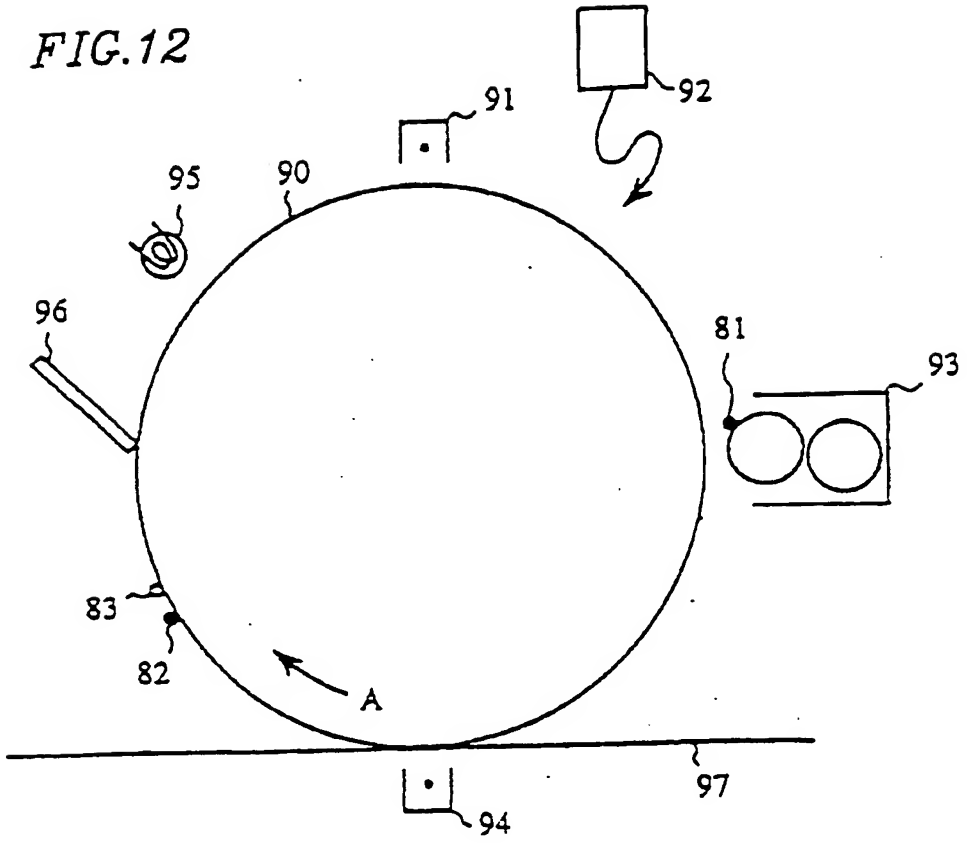


FIG.11

FIG.12



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 7917

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	US-A-5 257 079 (LANGE ET AL.) * abstract; figures 1-4 * * column 5, line 9 - column 7, line 5 *	1 2,3,5,7	G03G21/00
X A	US-A-4 989 047 (JUGLE ET AL.) * column 1, paragraph 1; figures 1,2 * * column 1, line 49 - column 2, line 14 * * claim 1 *	1 4	
D,A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 264 (P-610) 27 August 1987 & JP-A-62 067 577 (FUJITSU) 27 March 1987 * abstract *	1,2,5	
A	EP-A-0 366 426 (XEROX CORP.) * column 1, line 1 - column 2, line 52 * * column 3, line 47 - line 51 * * column 7, line 40 - column 9, line 16 * * column 9, line 32 - line 51; figures 1,2,4 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 August 1995	Greiser, N

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